

What is claimed is:

1. A method of treating a subterranean formation comprising the steps of:
providing a servicing fluid comprising a reduced-density particulate having a surface and a coating wherein the surface comprises a porous or partially hollow geometry and coating is capable of trapping a fluid between the particulate's surface and the coating; and,
placing the servicing fluid into the subterranean formation.
2. The method of claim 1 wherein the coating comprises a resin-type coating material.
3. The method of claim 2 wherein the resin-type coating material is a consolidation fluid comprising a hardenable resin component comprising a hardenable resin and a hardening agent component comprising a liquid hardening agent, a silane coupling agent, and a surfactant.
4. The method of claim 2 wherein the hardenable resin in the liquid hardenable resin component is an organic resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolak resin, polyester resin, phenol-aldehyde resin, urea-aldehyde resin, furan resin, urethane resin, glycidyl ethers, or mixtures thereof.
5. The method of claim 2 wherein the liquid hardening agent in the liquid hardening agent component comprises amines, aromatic amines, aliphatic amines, cyclo-aliphatic amines, piperidine, triethylamine, benzyldimethylamine, N,N-dimethylaminopyridine, 2-(N₂N-dimethylaminomethyl)phenol, tris(dimethylaminomethyl)phenol, or mixtures thereof.
6. The method of claim 2 wherein the silane coupling agent in the liquid hardening agent component comprises N-2-(aminoethyl)-3-aminopropyltrimethoxysilane, 3-glycidoxypropyltrimethoxysilane, n-beta-(aminoethyl)-gamma-aminopropyl trimethoxysilane or mixtures thereof.
7. The method of claim 2 wherein the surfactant in the liquid hardening agent component comprises ethoxylated nonyl phenol phosphate ester, mixtures of one or more cationic surfactants, a C₁₂ – C₂₂ alkyl phosphonate surfactant, one or more non-ionic surfactants and an alkyl phosphonate surfactant, or mixtures thereof.
8. The method of claim 2 wherein the resin-type coating material is a furan-based resin comprising furfuryl alcohol, a mixture furfuryl alcohol with an aldehyde, a mixture of furan resin and phenolic resin or mixtures thereof.

9. The method of claim 8 further comprising a solvent comprising 2-butoxy ethanol, butyl acetate, furfuryl acetate, or mixtures thereof.

10. The method of claim 2 wherein the resin-type coating material is a phenolic-based resin comprising terpolymer of phenol, phenolic formaldehyde resin, a mixture of phenolic and furan resin, or mixtures thereof.

11. The method of claim 10 further comprising a solvent comprising butyl acetate, butyl lactate, furfuryl acetate, 2-butoxy ethanol, or mixtures thereof.

12. The method of claim 2 wherein the resin-type coating material is a HT epoxy-based resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolac resin, polyester resin, glycidyl ethers, or mixtures thereof.

13. The method of claim 12 further comprising a solvent comprising dimethyl sulfoxide, dimethyl formamide, dipropylene glycol methyl ether, dipropylene glycol dimethyl ether, dimethyl formamide, diethylene glycol methyl ether, ethylene glycol butyl ether, diethylene glycol butyl ether, propylene carbonate, d'limonene, fatty acid methyl esters, or mixtures thereof.

14. The method of claim 1 wherein the coating comprises a tackifying coating material.

15. The method of claim 14 wherein the tackifying coating material is a polyamide, polyesters, polycarbonates, polycarbamates, natural resins, or combinations thereof.

16. The method of claim 1 wherein the coating comprises a degradable coating material.

17. The method of claim 16 wherein the degradable coating material comprises a degradable polymer.

18. The method of claim 17 wherein the degradable coating material comprises polysaccharides, chitins, chitosans, proteins, aliphatic polyesters, poly(lactides), poly(glycolides), poly(ϵ -caprolactones), poly(hydroxybutyrates), poly(anhydrides), aliphatic polycarbonates, poly(orthoesters), poly(amino acids), poly(ethylene oxides), polyphosphazenes, or combinations thereof.

19. The method of claim 17 wherein the degradable coating material comprises a stereoisomer of poly(lactide).

20. The method of claim 17 wherein the degradable coating material comprises a plasticizer.

21. A method of fracturing a subterranean formation comprising the steps of:
providing a fracturing fluid comprising a reduced-density particulate having a surface and a coating wherein the surface comprises a porous or partially hollow geometry and coating is capable of trapping a fluid between the particulate's surface and the coating; and,
placing the fracturing fluid into the subterranean formation at a pressure sufficient to create at least one fracture therein; and

removing the fracturing fluid while leaving at least a portion of the reduced-density, coated particulate in the fracture.

22. The method of claim 21 wherein the coating comprises a resin-type coating material.

23. The method of claim 22 wherein the resin-type coating material is a consolidation fluid comprising a hardenable resin component comprising a hardenable resin and a hardening agent component comprising a liquid hardening agent, a silane coupling agent, and a surfactant.

24. The method of claim 22 wherein the hardenable resin in the liquid hardenable resin component is an organic resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolak resin, polyester resin, phenol-aldehyde resin, urea-aldehyde resin, furan resin, urethane resin, glycidyl ethers, or mixtures thereof.

25. The method of claim 23 wherein the liquid hardening agent in the liquid hardening agent component comprises amines, aromatic amines, aliphatic amines, cycloaliphatic amines, piperidine, triethylamine, benzyldimethylamine, N,N-dimethylaminopyridine, 2-(N,N-dimethylaminomethyl)phenol, tris(dimethylaminomethyl)phenol, or mixtures thereof.

26. The method of claim 23 wherein the silane coupling agent in the liquid hardening agent component comprises N-2-(aminoethyl)-3-aminopropyltrimethoxysilane, 3-glycidoxypropyltrimethoxysilane, n-beta- (aminoethyl)-gamma-aminopropyl trimethoxysilane or mixtures thereof.

27. The method of claim 23 wherein the surfactant in the liquid hardening agent component comprises ethoxylated nonyl phenol phosphate ester, mixtures of one or more cationic surfactants, a C₁₂ – C₂₂ alkyl phosphonate surfactant, one or more non-ionic surfactants and an alkyl phosphonate surfactant, or mixtures thereof.

28. The method of claim 23 wherein the resin-type coating material is a furan-based resin comprising furfuryl alcohol, a mixture furfuryl alcohol with an aldehyde, a mixture of furan resin and phenolic resin or mixtures thereof.

29. The method of claim 23 further comprising a solvent comprising 2-butoxy ethanol, butyl acetate, furfuryl acetate, or mixtures thereof.

30. The method of claim 23 wherein the resin-type coating material is a phenolic-based resin comprising terpolymer of phenol, phenolic formaldehyde resin, a mixture of phenolic and furan resin, or mixtures thereof.

31. The method of claim 30 further comprising a solvent wherein the solvent comprises butyl acetate, butyl lactate, furfuryl acetate, 2-butoxy ethanol, or mixtures thereof.

32. The method of claim 22 wherein the resin-type coating material is a HT epoxy-based resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolac resin, polyester resin, glycidyl ethers, or mixtures thereof.

33. The method of claim 21 further comprising a solvent comprising dimethyl sulfoxide, dimethyl formamide, dipropylene glycol methyl ether, dipropylene glycol dimethyl ether, dimethyl formamide, diethylene glycol methyl ether, ethylene glycol butyl ether, diethylene glycol butyl ether, propylene carbonate, d'limonene, fatty acid methyl esters, or mixtures thereof.

34. The method of claim 21 wherein the coating comprises a tackifying coating material.

35. The method of claim 33 wherein the tackifying coating material is a polyamide, polyesters, polycarbonates, polycarbamates, natural resins, or combinations thereof.

36. The method of claim 21 wherein the coating comprises a degradable coating material.

37. The method of claim 36 wherein the degradable coating material comprises a degradable polymer.

38. The method of claim 37 wherein the degradable coating material comprises polysaccharides, chitins, chitosans, proteins, aliphatic polyesters, poly(lactides), poly(glycolides), poly(ϵ -caprolactones), poly(hydroxybutyrates), poly(anhydrides), aliphatic polycarbonates, poly(orthoesters), poly(amino acids), poly(ethylene oxides), polyphosphazenes, or combinations thereof.

39. The method of claim 37 wherein the degradable coating material comprises a stereoisomer of poly(lactide).

40. The method of claim 37 wherein the degradable coating material comprises a plasticizer.

41. A method of installing a gravel pack comprising the steps of:
providing a gravel packing fluid comprising a reduced-density particulate having a surface and a coating wherein the surface comprises a porous or partially hollow geometry and coating is capable of trapping a fluid between the particulate's surface and the coating; and,
introducing the gravel packing fluid to the well bore so that the reduced-density gravel forms a gravel pack substantially adjacent to the well bore.

42. The method of claim 41 wherein the coating comprises a resin-type coating material.

43. The method of claim 42 wherein the resin-type coating material is a consolidation fluid comprising a hardenable resin component comprising a hardenable resin and a hardening agent component comprising a liquid hardening agent, a silane coupling agent, and a surfactant.

44. The method of claim 43 wherein the hardenable resin in the liquid hardenable resin component is an organic resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolak resin, polyester resin, phenol-aldehyde resin, urea-aldehyde resin, furan resin, urethane resin, glycidyl ethers, or mixtures thereof.

45. The method of claim 43 wherein the liquid hardening agent in the liquid hardening agent component comprises amines, aromatic amines, aliphatic amines, cyclo-aliphatic amines, piperidine, triethylamine, benzyldimethylamine, N,N-dimethylaminopyridine, 2-(N₂N-dimethylaminomethyl)phenol, tris(dimethylaminomethyl)phenol, or mixtures thereof.

46. The method of claim 43 wherein the silane coupling agent in the liquid hardening agent component comprises N-2-(aminoethyl)-3-aminopropyltrimethoxysilane, 3-glycidoxypropyltrimethoxysilane, n-beta- (aminoethyl)-gamma-aminopropyl trimethoxysilane or mixtures thereof.

47. The method of claim 43 wherein the surfactant in the liquid hardening agent component comprises ethoxylated nonyl phenol phosphate ester, mixtures of one or more cationic surfactants, a C₁₂ – C₂₂ alkyl phosphonate surfactant, one or more non-ionic surfactants and an alkyl phosphonate surfactant, or mixtures thereof.

48. The method of claim 42 wherein the resin-type coating material is a furan-based resin comprising furfuryl alcohol, a mixture furfuryl alcohol with an aldehyde, a mixture of furan resin and phenolic resin or mixtures thereof.

49. The method of claim 48 further comprising a solvent comprising 2-butoxy ethanol, butyl acetate, furfuryl acetate, or mixtures thereof.

50. The method of claim 42 wherein the resin-type coating material is a phenolic-based resin comprising terpolymer of phenol, phenolic formaldehyde resin, a mixture of phenolic and furan resin, or mixtures thereof.

51. The method of claim 50 further comprising a solvent comprising butyl acetate, butyl lactate, furfuryl acetate, 2-butoxy ethanol, or mixtures thereof.

52. The method of claim 42 wherein the resin-type coating material is a HT epoxy-based resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolac resin, polyester resin, glycidyl ethers, or mixtures thereof.

53. The method of claim 52 further comprising a solvent comprising dimethyl sulfoxide, dimethyl formamide, dipropylene glycol methyl ether, dipropylene glycol dimethyl ether, dimethyl formamide, diethylene glycol methyl ether, ethylene glycol butyl ether, diethylene glycol butyl ether, propylene carbonate, d'limonene, fatty acid methyl esters, or mixtures thereof.

54. The method of claim 41 wherein the coating comprises a tackifying coating material.

55. The method of claim 54 wherein the tackifying coating material is a polyamide, polyesters, polycarbonates, polycarbamates, natural resins, or combinations thereof.

56. The method of claim 41 wherein the coating comprises a degradable coating material.

57. The method of claim 56 wherein the degradable coating material comprises a degradable polymer.

58. The method of claim 57 wherein the degradable coating material comprises polysaccharides, chitins, chitosans, proteins, aliphatic polyesters, poly(lactides), poly(glycolides), poly(ϵ -caprolactones), poly(hydroxybutyrates), poly(anhydrides), aliphatic polycarbonates, poly(orthoesters), poly(amino acids), poly(ethylene oxides), polyphosphazenes, or combinations thereof.

59. The method of claim 57 wherein the degradable coating material comprises a stereoisomer of poly(lactide).

60. The method of claim 57 wherein the degradable coating material comprises a plasticizer.

61. A reduced-density, coated particulate comprising a particulate having a surface and a coating wherein the surface comprises a porous or partially hollow geometry and coating is capable of trapping a fluid between the particulate's surface and the coating.

62. The particulate of claim 61 wherein the coating comprises a resin-type coating material.

63. The particulate of claim 62 wherein the resin-type coating material is a consolidation fluid comprising a hardenable resin component comprising a hardenable resin and a hardening agent component comprising a liquid hardening agent, a silane coupling agent, and a surfactant.

64. The particulate of claim 63 wherein the hardenable resin in the liquid hardenable resin component is an organic resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolak resin, polyester resin, phenol-aldehyde resin, urea-aldehyde resin, furan resin, urethane resin, glycidyl ethers, or mixtures thereof.

65. The particulate of claim 63 wherein the liquid hardening agent in the liquid hardening agent component comprises amines, aromatic amines, aliphatic amines, cycloaliphatic amines, piperidine, triethylamine, benzyldimethylamine, N,N-dimethylaminopyridine, 2-(N,N-dimethylaminomethyl)phenol, tris(dimethylaminomethyl)phenol, or mixtures thereof.

66. The particulate of claim 63 wherein the silane coupling agent in the liquid hardening agent component comprises N-2-(aminoethyl)-3-aminopropyltrimethoxysilane, 3-glycidoxypropyltrimethoxysilane, n-beta- (aminoethyl)-gamma-aminopropyl trimethoxysilane or mixtures thereof.

67. The particulate of claim 63 wherein the surfactant in the liquid hardening agent component comprises ethoxylated nonyl phenol phosphate ester, mixtures of one or more cationic surfactants, a C₁₂ – C₂₂ alkyl phosphonate surfactant, one or more non-ionic surfactants and an alkyl phosphonate surfactant, or mixtures thereof.

68. The particulate of claim 62 wherein the resin-type coating material is a furan-based resin comprising furfuryl alcohol, a mixture furfuryl alcohol with an aldehyde, a mixture of furan resin and phenolic resin or mixtures thereof.

69. The particulate of claim 68 further comprising a solvent comprising 2-butoxy ethanol, butyl acetate, furfuryl acetate, or mixtures thereof.

70. The particulate of claim 62 wherein the resin-type coating material is a phenolic-based resin comprising terpolymer of phenol, phenolic formaldehyde resin, a mixture of phenolic and furan resin, or mixtures thereof.

71. The particulate of claim 70 further comprising a solvent comprising butyl acetate, butyl lactate, furfuryl acetate, 2-butoxy ethanol, or mixtures thereof.

72. The particulate of claim 62 wherein the resin-type coating material is a HT epoxy-based resin comprising bisphenol A-epichlorohydrin resin, polyepoxide resin, novolac resin, polyester resin, glycidyl ethers, or mixtures thereof.

73. The particulate of claim 72 further comprising a solvent comprising dimethyl sulfoxide, dimethyl formamide, dipropylene glycol methyl ether, dipropylene glycol dimethyl ether, dimethyl formamide, diethylene glycol methyl ether, ethylene glycol butyl ether, diethylene glycol butyl ether, propylene carbonate, d'limonene, fatty acid methyl esters, or mixtures thereof.

74. The particulate of claim 71 wherein the coating comprises a tackifying coating material.

75. The particulate of claim 74 wherein the tackifying coating material is a polyamide, polyesters, polycarbonates, polycarbamates, natural resins, or combinations thereof.

76. The method of claim 71 wherein the coating comprises a degradable coating material.

77. The method of claim 76 wherein the degradable coating material comprises a degradable polymer.

78. The method of claim 77 wherein the degradable coating material comprises polysaccharides, chitins, chitosans, proteins, aliphatic polyesters, poly(lactides), poly(glycolides), poly(ϵ -caprolactones), poly(hydroxybutyrates), poly(anhydrides), aliphatic polycarbonates, poly(orthoesters), poly(amino acids), poly(ethylene oxides), polyphosphazenes, or combinations thereof.

79. The method of claim 77 wherein the degradable coating material comprises a stereoisomer of poly(lactide).

80. The method of claim 77 wherein the degradable coating material comprises a plasticizer.